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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Su Yi Liu et al

Serial No. 10/003,537 Examiner: Jan M. Ludlow

Filing Date: 10/30/2001 Group Art Unit: 1743

For: Pipette Piston Seal Assembly

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. 1.132

Sir:

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe that I am a co-inventor of the invention described and claimed in U.S. Patent Application Serial No. 10/003,537 entitled Pipette Piston Seal Assembly, for which a patent is sought. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby state that I have reviewed and understand the contents of the specification, including the claims of the above-identified patent application. I have a Bachelors degree in physics and a Doctorate degree in biophysics. Further, I have fourteen (14) years experience in the research and development of laboratory apparatus including many liquid-handling devices. In my opinion, it is not at all obvious to improve the performance of polyethylene as a piston seal by increasing the molecular weight.

Although it is true that ultra high molecular weight polyethylene (UHMWPE) and other forms of polyethylene are essentially the same chemical with different molecular weights, their physical properties, fabrication method, and industrial applications are totally different. UHMWPE is normally considered to be in a totally different class than the other forms of polyethylene (including HDPE, LDPE, LLDPE, ULDPE and VLDPE). For example, in one widely used engineering plastics book, *Engineered Materials Handbook V2 Engineering Plastics* (ISBN 0-87170-279-7 ASM International), UHMWPE is discussed

in a separate chapter from HDPE. In addition, UHMWPE has significantly different properties compared to other polyethylene materials. For example, UHMWPE has both the highest abrasion resistance and impact resistance of any plastic (*Engineered Materials Handbook V2 Engineering Plastics*, p. 167). Its abrasion resistance is 1.6 times greater than stainless steel and 5.3 times greater that PTFE. Another trade publication by Ticona (publication B245BR GB-9098/101) indicates that the abrasion resistance of their GUR4170 grade UHMWPE is 6 times better than high molecular-weight HDPE (Fig. 15, page 14). From Montell Polyolefins' literature " 1900 UHMWPE "(publication PL-114), we can see that: its static coefficient of friction is 66% lower than HDPE and 20% lower than PTFE. Its notched Izod impact strength is 4.6 times higher than HDPE. Its double-notched Izod impact strength is 19.4 times higher than HDPE.

Factories that process UHMWPE are very different than the factories that process lower molecular weight polyethylene. UHMWPE can't be processed, as lower molecular weight polyethylene can, with techniques such as injection modeling or extrusion. It is necessary to use compression molding and ram extrusion. Due to the cost of material and processing, UHMWPE is only used where its special properties are critical for the application. One of the main markets of UHMWPE is for applications that need extra wear resistance such as bulk material handling. Impact resistance, chemical stability, and low friction are three other factors for its use. Most of these applications can never be substituted by using lower molecular weight polyethylene (including HDPE, LDPE, LLDPE, ULDPE and VLDPE). On the other hand, applications that use lower molecular weight polyethylene might be substituted sometimes between each other or even by polypropylene (PP) but not UHMWPE.

Pipettes having conventional seals composed of PTFE or lower molecular weight polyethylene have a high failure rate, and the mechanism for such failure has not been understood. While PTFE has better wear resistance, better abrasion resistance, and a lower friction coefficient than lower molecular weight polyethylene materials, experiments have shown that PTFE pipette seals have a shorter lifetime than lower molecular weight polyethylene pipette seals.

Although it is well known that PTFE has poor creep resistance under high load, pipette seals are not subjected to high load and this performance characteristic of PTFE was not expected to have any impact on the performance of PTFE seals. Our investigation and experiments have demonstrated that low load induced creep of conventional PTFE pipette seals results in loss of the pipette sealing grease, and that this combination of events is the failure mechanism for conventional PTFE pipette seals. Our experiments have also demonstrated the creep resistance of UHMWPE under very low load is much greater than that of PTFE. The creep resistance performance of UHMWPE under very low load was not known prior to our experiments. Given the fact that the creep resistance of UHMWPE under high load is only slightly better than that of PTFE, the degree of difference in the low load creep resistance between the two materials was completely unexpected.

It must be emphasized that extensive testing was required to discover both the failure mechanism of conventional PTFE pipette seals and the superior low load creep resistance of UHMWPE.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful and false statements may jeopardize the validity of the application or any patent issued thereon.

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